

## ASSIGNMENT 1

Textbook Assignment: "Levers," chapter 1, pages 1-1 through 1-8; Block and Tackle," chapter 2, pages 2-1 through 2--6; "The Wheel and Axle," chapter 3, pages 3-1 through 3-6; "The Inclined Plane and the Wedge," chapter 4, pages: 4-1 through 4-2.

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| <p>1-1. A chain hoist lifts a 300-pound load through a height of 10 feet because it enables you to lift the load by exerting less than 300 pounds of force over a distance of 10 feet or less.</p> <ol style="list-style-type: none"><li>1. True</li><li>2. False</li></ol> <p>1-2. When a chain hoist is used to multiply the force being exerted on a load, the chain is pulled at a faster rate than the load travels.</p> <ol style="list-style-type: none"><li>1. True</li><li>2. False</li></ol> <p>1-3. What are the six basic simple machines?</p> <ol style="list-style-type: none"><li>1. The lever, the block and tackle, the inclined plane, the engine, the wheel and axle, and the gear</li><li>2. The lever, the block and tackle, the wheel and axle, the screw, the gear, and the eccentric</li><li>3. The lever, the block and tackle, the wheel and axle, the inclined plane, the screw, and the gear</li><li>4. The lever, the inclined plane, the gear, the screw, the fulcrum, and the torque</li></ol> | <p>1-4. Which of the following basic principles is recognized by physicists as governing each simple machine?</p> <ol style="list-style-type: none"><li>1. The wedge or the screw</li><li>2. The wheel and axle or the gear</li><li>3. The lever or the inclined plane</li><li>4. The block and tackle or the wheel and axle</li></ol> <p>1-5. Which of the following simple machines works on the same principle as the inclined plane?</p> <ol style="list-style-type: none"><li>1. Screw</li><li>2. Gear</li><li>3. Wheel and axle</li><li>4. Block and tackle</li></ol> <p>1-6. The fundamentally important points in any lever problem are (1) the point at which the force is applied, (2) the fulcrum, and (3) the point at which the</p> <ol style="list-style-type: none"><li>1. lever will balance</li><li>2. resistance arm equals the effort arm</li><li>3. mechanical advantage begins to increase</li><li>4. resistance is applied</li></ol> |
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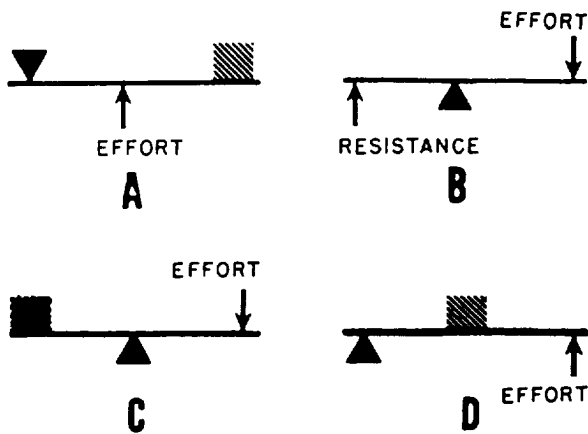


Figure 1A.

QUESTIONS 1-7 THROUGH 1-9 RELATE TO THE DRAWINGS IN FIGURE 1A.

- 1-7. Which, if any, of the following parts illustrates a first class lever?
1. A
  2. B or C
  3. D
  4. None of the above
- 1-8. Which part illustrates a second-class lever?
1. D
  2. C
  3. B
  4. A
- 1-9. What part illustrates a third-class lever?
1. A
  2. B
  3. C
  4. D
- 1-10. Which of the following classes of levers should you use to lift a large weight by exerting the least effort?
1. First-class
  2. Second-class
  3. First- or second-class
  4. Third-class

- 1-11. You will find it advantageous to use a third-class lever when the desired result is

1. a transformation of energy
2. an increase in speed
3. a decrease in applied effort
4. a decrease in speed and an increase in applied effort

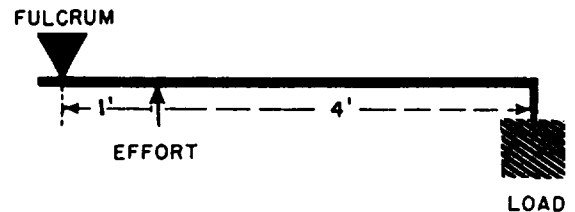


Figure 1B

IN ANSWERING QUESTIONS 1-12 THROUGH 1-14, SELECT THE CORRECT ARM MEASUREMENTS FROM FIGURES 1B AND 1C.

- 1-12. Effort arm in figure 1B
1. 1 ft
  2. 3 ft
  3. 4 ft
  4. 5 ft
- 1-13. Resistance arm in figure 1B
1. 1 ft
  2. 3 ft
  3. 4 ft
  4. 5 ft
- 1-14. Resistance arm in figure 1C
1. 1 ft
  2. 3 ft
  3. 4 ft
  4. 5 ft

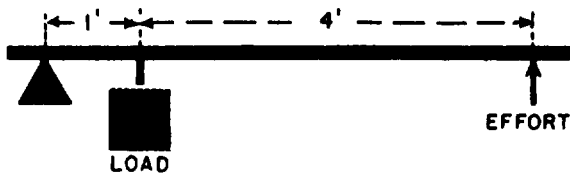


Figure 1C

1-15. Two boys find that they can balance each other on a plank if one sits six feet from the fulcrum and the other eight feet. The heavier boy weighs 120 pounds. How much does the lighter boy weigh?

1. 90 lb
2. 106 lb
3. 112 lb
4. 114 lb

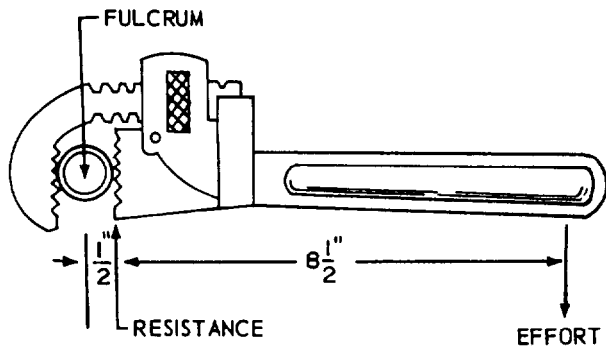


Figure 1D

1-16. With the aid of the pipe wrench shown in figure 1D, how many pounds of effort will you need to exert to overcome a resistance of 900 pounds?

1. 25 lb
2. 50 lb
3. 75 lb
4. 100 lb

Questions 1-17 and 1-18 are related to a 300-pound load of firebrick stacked on a wheelbarrow. Assume that the weight of the firebrick is centered at a point and the barrow axle is 1 1/2 feet forward of the point.

1-17. If a Seaman grips the barrow handles at a distance of three feet from the point, how many total pounds will the Seaman have to lift to move the barrow?

1. 65 lb
2. 100 lb
3. 150 lb
4. 300 lb

1-18. If a Seaman grasps the handles 3 1/2 feet from the point where the weight is centered, how many pounds of effort will be exerted?

1. 50 lb
2. 90 lb
3. 100 lb
4. 120 lb

1-19. In lever problems, the length of the effort arm multiplied by the effort is equal to the length of the

1. resistance arm multiplied by the effort
2. resistance arm multiplied by the resistance
3. effort arm multiplied by the resistance arm
4. effort arm multiplied by the resistance

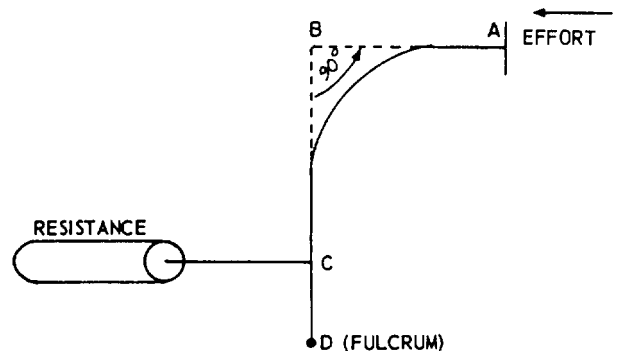


Figure 1E.—A curved lever.

1-20. The length of the effort arm in figure 1E is equal to the length of the

1. curved line from A to C
2. curved line from A to D
3. straight line from B to C
4. straight line from B to D

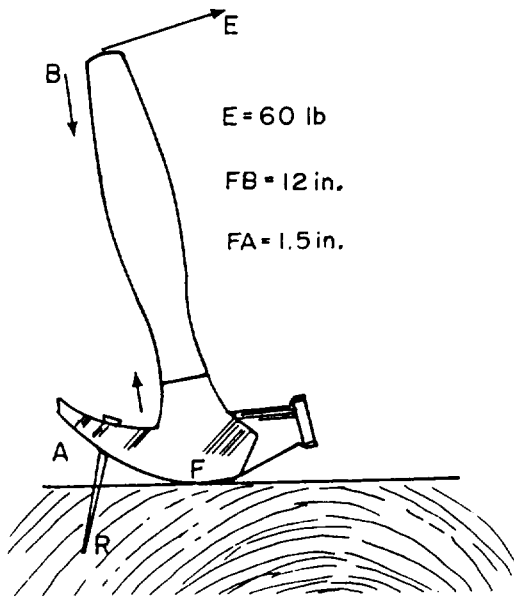


Figure 1F

1-21. Refer to figure 1F. If a person exerts at point B a pull of 60 pounds on the claw hammer shown, what is the resistance that the nail offers?

1. 60 lb
2. 120 lb
3. 480 lb
4. 730 lb

1-22. Which of the following definitions describes the mechanical advantage of the lever?

1. Effort that must be applied to overcome the resistance of an object divided by the resistance of the object
2. Amount of work obtained from the effort applied
3. Gain in power obtained by the use of the lever
4. Resistance offered by an object divided by the effort which must be applied to overcome this resistance

1-23. The mechanical advantage of levers can be determined by dividing the length of the effort arm by the

1. distance between the load and the point where effort is applied
2. distance between the fulcrum and the point where effort is applied
3. distance between the load and the fulcrum
4. amount of resistance offered by the object

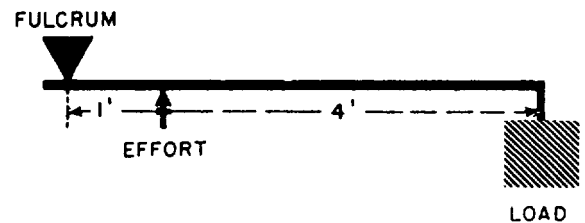


Figure 1G

1-24. The mechanical advantage of the lever in figure 1G is

1. one-fifth
2. one-fourth
3. four
4. five

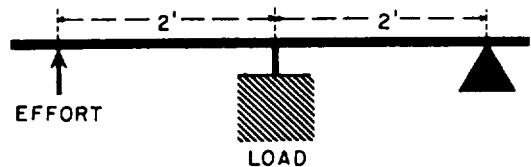


Figure 1H

1-25. The mechanical advantage of the lever in figure 1H is

1. one
2. two
3. one-half
4. one-fourth

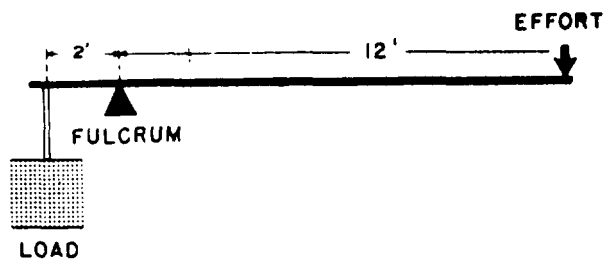


Figure 1J

1-26. The mechanical advantage of the lever pictured in figure 1J is

1. five
2. six
3. seven
4. one-sixth

1-27. The combination dog and wedge of textbook figure 1-10 is a complex machine since it consists of which two simple machines?

1. Lever and the screw
2. Two first-class levers
3. Lever and the inclined plane
4. One first-class lever and one second-class lever

Information for questions 1-28 and

1-29: The handle of a hatch dog is 9 inches long. The short arm is 3 inches long.

1-28. What is the mechanical advantage of the hatch dog?

1. 12
2. 27
3. 3
4. 9

1-29. With how much force must you push down on the handle to exert 210 pounds force on the end of the short arm?

1. 105 lb
2. 80 lb
3. 70 lb
4. 25 lb

1-30. The rope in a block and tackle is called a

1. runner
2. line
3. fall
4. sheave

1-31. The theoretical mechanical advantage of the single sheave block of textbook figure 2-2 is

1. one
2. two
3. one-half
4. zero

1-32. A single block-and-fall rigged as a runner has a theoretical mechanical advantage of

1. one
2. two
3. one-half
4. four

1-33. In a block and tackle having a mechanical advantage greater than one, how does the distance the load moves compare with the length of the rope which is pulled through the block?

1. It is less
2. It is the same
3. It is greater
4. It depends on the weight of the load

1-34. What advantage can you obtain by replacing the single fixed block of textbook figure 2-3 with the gun tackle purchase of textbook figure 2-6?

1. You can pull the rope from a more convenient position
2. You need to exert about 1/3 as much effort to lift the same load
3. You can lift the same load in 1/2 the time
4. You need to exert about 1/2 as much effort to lift the same load

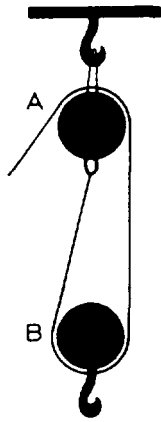


Figure 1K

1-35. In the arrangement of figure 1K the purpose of block A is to

1. increase the mechanical advantage of the block
2. change the direction of the applied force
3. hold up block B
4. act as a runner for block B

1-36. A luff tackle is a block and tackle consisting of a

1. fixed double block and a movable single block
2. movable double block and a fixed single block
3. fixed single block and a movable single block
4. fixed triple block and a movable double block

Information for questions 1-37 and 1-38: Alone you're going to hoist a 600-pound load to a height of 36 feet. You can pull 160 pounds' worth. You have to use a fixed block fastened to a beam above you. You have a movable block attached to the pad eye of the load.

1-37. What minimum mechanical advantage must the block and tackle provide?

1. One
2. Two
3. Three
4. Four

1-38. For which requirement will it be to your advantage to rig a yard to a stay tackle if each tackle has a theoretical mechanical advantage of two?

1. A theoretical mechanical advantage of 4
2. A change in the direction of pull for convenience
3. A heavy crate to be lifted to the other side of a low fence
4. An increase in speed

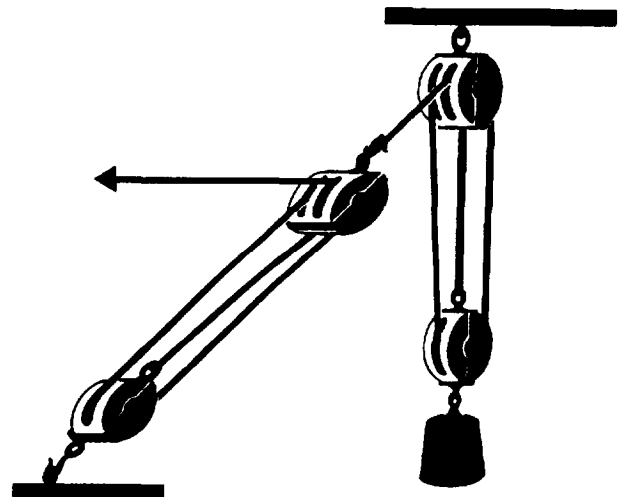


Figure 1L

1-39. The overall mechanical advantage in figure 1L is about

1. five
2. six
3. eight
4. twelve

1-40. You are using a differential pulley to lift a load of 2,400 pounds. Fifty pounds of effort are required to overcome the frictional resistance of the pulley. What force is necessary to lift the load if the theoretical mechanical advantage of the pulley is 24?

1. 50 lb
2. 100 lb
3. 150 lb
4. 200 lb

1-41. With a block and tackle the effort has to move 125 feet in order to raise a load 25 feet. The friction is so great that it takes a force of 75 pounds to lift a load of 300 pounds. The actual mechanical advantage is

1. five
2. two
3. three
4. four

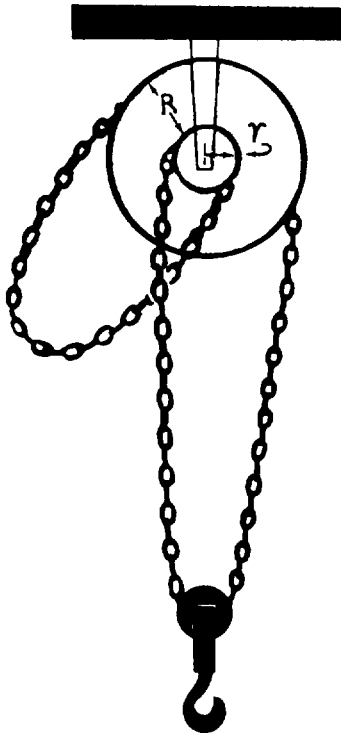


Figure 1M

1-42. The theoretical mechanical advantage of a differential pulley, such as the one pictured in figure 1M, depends upon the

1. difference in diameters of the two top pulleys
2. sum of diameters of the two top pulleys
3. length of the chain
4. difference in diameters of the two small pulleys

1-43. In the differential pulley pictured in figure 1M, if the radius of the small pulley at the top is 3 inches, the radius of the large pulley at the top is 4 inches, and the radius of the pulley at the bottom is  $2\frac{1}{2}$  inches, the theoretical mechanical advantage is

1. 8
2. 9
3. 30
4. 36

1-44. Why is the actual mechanical advantage of the differential pulley of textbook figure 2-11 never so great as the theoretical mechanical advantage of the pulley?

1. Part of the effort applied to the chain is used to overcome the frictional resistance of the pulley's moving parts
2. The diameter of C is between those of A and B
3. The diameter of A is greater than that of B
4. The length of the chain fed down is greater than the length of the chain fed up

1-45. A wheel and axle can rotate clockwise or counterclockwise about an axis to provide a mechanical advantage or an increase in speed.

1. True
2. False

1-46. The mechanical advantage of a wheel and axle depends upon the

1. amount of force applied and the size of the wheel
2. size of the wheel and the amount of the resistance
3. ratio of the radius of the wheel to which force is applied to the radius of the axle on which it turns
4. length of the axle

1-47. What maximum load can you lift by applying a 50-pound force to the handle of an 18-inch crank that is connected to a 9-inch-diameter drum of a hand winch?

1. 50 lb
2. 100 lb
3. 150 lb
4. 200 lb

1-48. The moment resulting from a force acting on a wheel and axle is equal to the

1. amount of force required to produce equilibrium in a wheel and axle
2. ratio of the force to the distance from the center of rotation
3. distance from the point where the force is applied to the center of the axle
4. product of the amount of the force and the distance of the force from the center of rotation

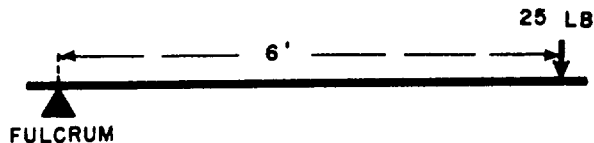


Figure 1N

1-49. The clockwise moment of force about the fulcrum of figure 1N is

1.  $4 \frac{2}{3}$  ft-lb
2. 6 ft-lb
3. 25 ft-lb
4. 150 ft-lb

1-50. If in the lever shown in figure 1N both the amount of force and the distance between the fulcrum and the point where force is applied are doubled, the torque will be

1.  $\frac{1}{2}$  as great as before the changes were made
2. 2 times as great as before the changes were made
3. 4 times as great as before the changes were made
4. 8 times as great as before the changes were made

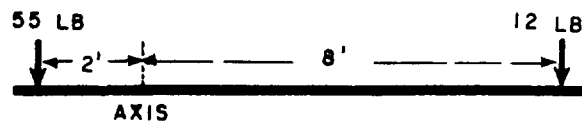


Figure 1P

1-51. What would be the resultant torque in figure 1P?

1. Clockwise torque of 10 ft-lb
2. Clockwise torque of 14 ft-lb
3. Counterclockwise torque of 10 ft-lb
4. Counterclockwise torque of 14 ft-lb

1-52. What will happen to a machine when clockwise and counterclockwise moments of force are in balance?

1. The machine will break down
2. The machine will either remain at rest or move at a steady speed
3. The machine will move at an increasing speed
4. The machine will move at a decreasing speed

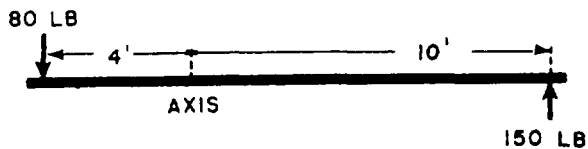


Figure 1Q

1-53. The result of forces acting as shown in figure 1Q would be a torque of

1. 600 ft-lb
2. 1,180 ft-lb
3. 1,820 ft-lb
4. 2,680 ft-lb

Information to answer questions 1-54 through 1-56: The service manual for an engine states that a certain nut is to be tightened by a moment of 90 foot-pounds.

1-54. If a wrench 18 inches long is used, the amount of force that should be exerted at the end of the wrench is

1. 5 lb
2. 9 lb
3. 60 lb
4. 162 lb

1-55. How many pounds of effort could be saved by using a two-foot long wrench?

1. 15 lb
2. 30 lb
3. 45 lb
4. 50 lb

1-56. What kind of wrench could you use that measures directly the amount of force you are exerting on the nut?

1. Pipe wrench
2. Torque wrench
3. Spanner wrench
4. Adjustable end wrench

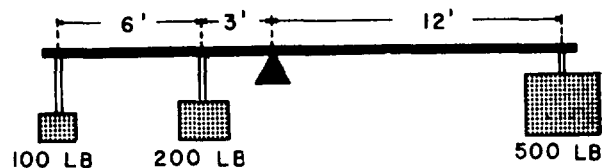


Figure 1R

1-57. The result of forces operating as shown in figure 1R is equivalent to a moment of

1. 300 ft-lb in a clockwise direction
2. 700 ft-lb in a counterclockwise direction
3. 4,500 ft-lb in a clockwise direction
4. 6,000 ft-lb in a counterclockwise direction

When answering questions 1-58 through 1-60, refer to figure 1S.

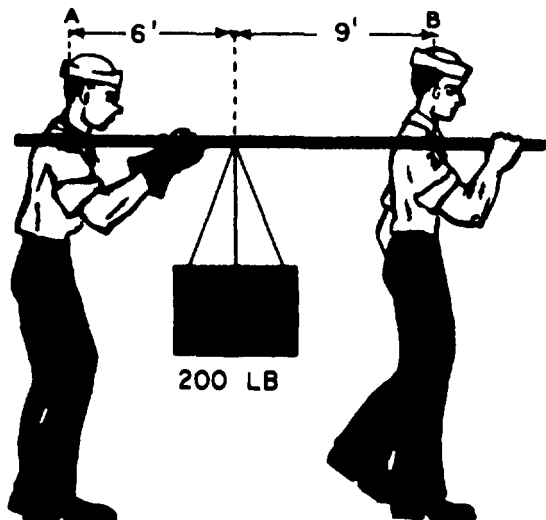


Figure 1S

1-58. The clockwise moment about A is

1. 200 ft-lb
2. 300 ft-lb
3. 1,200 ft-lb
4. 1,800 ft-lb

1-59. The counterclockwise moment about B is

1. 200 ft-lb
2. 1,200 ft-lb
3. 1,800 ft-lb
4. 3,000 ft-lb

1-60. How much of the load is the sailor at the right carrying?

1. 22  $\frac{2}{9}$  lb
2. 33  $\frac{1}{3}$  lb
3. 80 lb
4. 120 lb

1-61. The sailor in figure 3-4 in your textbook can increase his effectiveness without exerting a greater effort by using a shorter capstan bar.

1. True
2. False

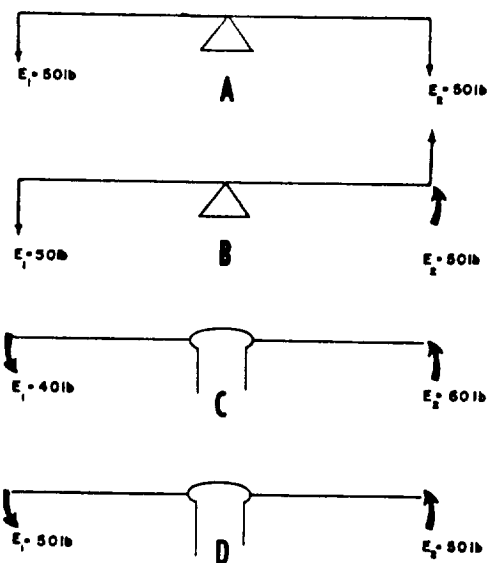


Figure 1T

1-62. Which of the parts of figure 1T represents the wheel and axle arrangement known as a couple?

1. A
2. B
3. C
4. D

1-63. A ship's deck is 24 feet above the dock. How long a gangplank is needed to provide a theoretical mechanical advantage of 2?

1. 24 ft
2. 48 ft
3. 60 ft
4. 96 ft

1-64. A sailor is rolling a 400-pound barrel up a 20-foot long ramp to a 3-foot height. Neglecting friction, the force needed to move the barrel up the ramp is

1. 60 lb
2. 133  $\frac{1}{3}$  lb
3. 200 lb
4. 220 lb

When answering questions 1-65 through 1-68, refer to figure 1U.

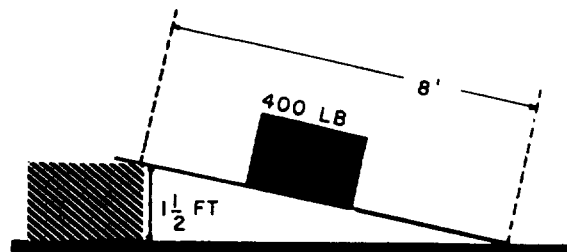


Figure 1U

1-65. The theoretical mechanical advantage of the inclined plane is

1.  $\frac{3}{16}$
2. 3
3. 5  $\frac{1}{3}$
4. 6

1-66. Neglecting friction, the force, needed to pull the crate up the inclined plane is

1. 50 lb
2. 75 lb
3. 124 lb
4. 600 lb

1-67. If a force of 133 pounds is actually required to move the crate up the inclined plane, the amount of force expended in overcoming friction is

1. 20 lb
2. 33 lb
3. 58 lb
4. 66 lb

1-68. Since a force of 133 pounds was exerted in moving the crate up the inclined plane, the actual mechanical advantage is

1.  $\frac{1}{3}$
2.  $2\frac{1}{3}$
3. 3
4. 4

1-69. A 3,000-pound automobile is towed up a ramp 150 feet long running from the street floor to the second floor of a garage. The towing force required was 300 pounds. What is the distance between floors if 20 pounds of force were needed to overcome frictional resistance?

1. 8.6 ft
2. 10 ft
3. 14 ft
4. 15 ft

Information for questions 1-70 and 1-71: By exerting an effort of 115 pounds, you move a 300-pound crate up an inclined plane 12 feet long to a truck bed three feet above the sidewalk.

1-70. What is the theoretical mechanical advantage of the inclined plane?

1. One
2. Two
3. Three
4. Four

1-71. How much of your effort is used to overcome friction?

1. 35 lb
2. 40 lb
3. 75 lb
4. 115 lb

1-72. What is the characteristic shape of wedges which have a high mechanical advantage?

1. Short and thick
2. Long and thin
3. Long and thick
4. Short and thin

1-73. If a wedge is 6 inches long, 3 inches wide, and  $1\frac{1}{2}$  inches thick at the top, the theoretical mechanical advantage is

1.  $1\frac{1}{2}$
2. 2
3. 3
4. 4

1-74. A member of a damage control party uses a maul to drive a wedge in behind a shore to tighten up a damaged bulkhead. The wedge is 15 inches long and 3 inches thick at the butt. How many pounds of force will be delivered against the face of the wedge by an 80-pound blow on the wedge butt with the maul?

1. 80 lb
2. 240 lb
3. 400 lb
4. 1,200 lb

1-75. A 60-pound blow delivered against the  $\frac{3}{4}$ -inch-thick butt end of a wedge results in an effective splitting force of 480 pounds. How long is the wedge?

1. 3 in
2. 4 in
3. 6 in
4. 8 in